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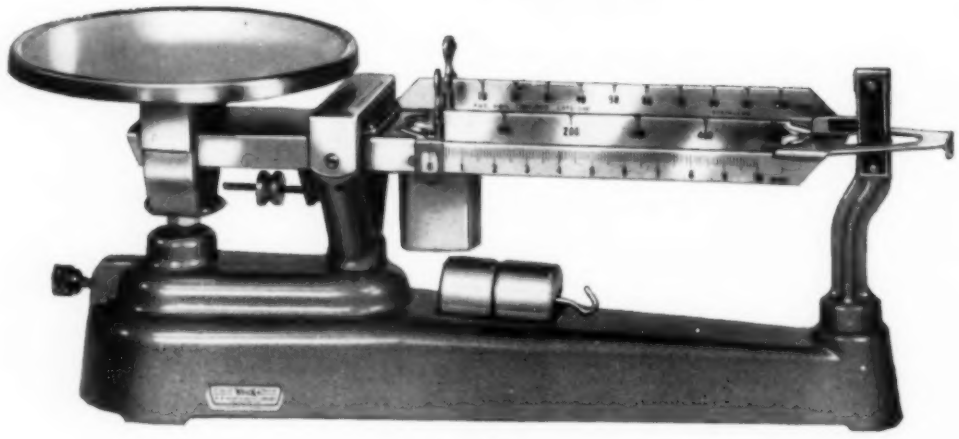

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Atomic Energy and the Educational Problems of Our Age

• By Clark D. Goodman, Ph.D., *(Massachusetts Institute of Technology)*
ASSISTANT DIRECTOR, DIVISION OF REACTOR DEVELOPMENT, U. S. ATOMIC ENERGY COMMISSION

This paper was presented at the Tenth Oak Ridge Symposium, University of Puerto Rico, San Juan, Puerto Rico, January 25, 1957.

While the author concerns himself primarily with Puerto Rico, his discussion applies equally well to all countries.

●

These remarks are addressed to students and teachers in this atomic age. As students you may have some unpleasant associations with "educational problems." You may be thinking of these as problems that must be solved to complete an assignment or to pass a final examination. On the other hand, as viewed by your professors, such problems are mainly necessary evils which may serve the questionable functions of making students study and of forming the basis for final grades.

The "educational problems" to which I wish to direct your attention are of quite a different sort. You have been living with them most of your life. You may have even become unaware of their existence. These educational problems are the obstacles you have met and will continue to meet in your preparation for life. For education is surely the preparation for life as well as for professional accomplishment.

In this sense, I believe the *number one* educational problem of our age is *the increasing complexity of our culture.* Science continues to shrink distance, to increase leisure and comfort, to reduce manual labor, to widen communications among mankind and to open new vistas of the mind. But to partake of this expanding existence you must pay for it. You must know and understand more. As students of the atomic age you must learn more and learn it faster. What is more as adults you must keep on learning in order to stay abreast of the times. Dr. Mortimer Graves, executive director of the American Council of Learned Societies, in an address last spring put it aptly when he said "to keep pace with this new age the American must learn as long as he lives; terminal education and the undertaker will arrive on the same day".

In its first interim report the President's Committee on Education emphasizes the need for every individual "to develop his or her talent to the fullest" to meet national needs and the increasing complexity of civilization. Furthermore, as my good friend Admiral H. G. Rickover recently stated before the Thomas A. Edison Foundation, "the more complex a society becomes, the larger proportionately is the number of intelligent, highly trained men needed for its proper functioning". He pointed out "that a 3 per cent annual increase in our gross national product will require 4½ to 5½ per cent annual increase in scientific and engineering manpower. Or, to put it differently, in the last 20 years our population has increased by 35 per cent, but the number of scientists has increased by 450 per cent, and engineers by 225 per cent. Yet even this tremendous increase leaves us seriously short."

With the rapid industrialization and population growth which you are experiencing in Puerto Rico, it will be necessary to increase your production of scientists and engineers at an even greater rate since many of your technically trained men and women migrate to the States or to South America. The purpose of this symposium is to assist you and your leaders in the effort that faces all of us to work out practical means of meeting these educational needs. In particular we feel that the peaceful applications of atomic energy provide a new and stimulating area in which to develop this expanded educational program.

In order to carry out such a program you will need more teachers, particularly those trained in nuclear science and technology. This brings us face to face with the second big educational problem of today. At a time when good technical teaching is most urgently needed, both in our colleges and in our high schools, *the number of trained teachers in the United States is decreasing at an alarming rate.* The number of qualified teachers of high school science and mathematics has fallen off about 53 per cent in the past five years while the high school student body has increased 16 per cent and continues to rise.

The Atomic Energy Commission is keenly aware of this and is doing a great deal to help solve the problem. Chairman Lewis L. Strauss and Commissioner Willard F. Libby have made numerous appeals to industrial, academic, government and philanthropic groups to awaken to this national need and to assist in bold, new educational programs designed to fill this need. They have sparkplugged vigorous training and education assistance programs by the Commission of which this symposium is but one example. Since your new nuclear curriculum will want to follow much the same pattern as the Commission's activities in some areas, I will summarize briefly our educational and training programs.

At the advanced level the Commission has established three special graduate schools, The Oak Ridge School of Reactor Technology which has graduated 469 students sponsored by American industries and government agencies. The International School of Nuclear Science and Engineering which has 100 alumni from 29 countries and The Oak Ridge Institute of Nuclear Studies which has provided training and specialized research facilities for 4800 students

and visiting faculty. As American universities take over the responsibility, these schools, which were established to meet emergency needs, are gradually being converted to advanced laboratory training centers.

AEC Fellowships in Nuclear Energy Technology (150 per year) in Radiological Physics (69 for 1956-57), and in Industrial Medicine (7 in 1956-57) are attracting talented scientists, engineers and physicians to these fields in which the need is especially acute. Graduate student research training (about 1180 per year) is provided through approximately 300 research contracts with about 100 colleges and universities. Summer courses have been conducted in nuclear reactor technology for engineering faculty (90 in 1956). Likewise an additional 285 university faculty members participated in research programs at AEC laboratories during the summer of 1956.

As you know, the Commission will provide assistance to educational institutions to acquire training reactors, teaching aids, demonstration apparatus, laboratory equipment, and certain nuclear materials to be used primarily for educational and training purposes in nuclear technology courses. The University of Puerto Rico is among the 34 colleges and universities granted such assistance thus far in this continuing program.

We now come to the third major educational problem of our age. This is *the language barrier.* Even if we had an adequate number of qualified teachers and students adjusted to the complexities of modern civilization, there must be easy communication in the classroom. Language serves this purpose—but it must be native, or nearly so, to both the teacher and the student. I recently spent a year in Japan as a Fulbright Professor at Osaka University. Fortunately the students in my nuclear physics course could all read English. Despite this advantage it was very difficult to communicate orally any but the simplest concepts—in a subject in which I feel concepts are the real keys to understanding. Needless to say, had it been necessary to communicate in written Japanese the barrier between us would have been almost impenetrable.

You are indeed fortunate in having an essentially bilingual university. Spanish and English have common roots and hence are very similar both in the written and in the spoken language. The University of Puerto Rico is, therefore, ideally suited geographically, culturally and academically to serve as an educational bridge between the Americans. There is a veritable flood of technical information in English but this needs to be reduced to Latin America's needs and presented in Spanish in order to be of greatest usefulness in most of the Central and South American countries.

Next we come to the fourth big educational problem which is particularly close to my heart but which is difficult to express simply and clearly. It is what I alluded to a moment ago. You might call it *conceptual teaching* as contrasted to factual teaching. This approach is applicable to nearly all fields of knowledge but is essential in the physical sciences. In brief the student should be presented with the true *educational essence* of mathematics, physics and chemistry. This does not mean that practical applications are ignored. Quite the opposite; for in the ultimate all knowledge is first derived from experience. The relevance of fundamental knowledge to real situations must be understood and put to practical use. However, in learning applied science the basic principles are often lost in a plethora of practical details. As a result the student finds it not only difficult to know where to hang his intellectual hat, but he is also likely to forget where he hung it. It is truly amazing how little we really need to remember and how much we can forget and still retain the real nourishment of a subject. I submit that there must be something wrong with our teaching for this to be the case. Clearly we can no longer afford the luxury of gorging our minds in much the same manner as we so often gorge our stomachs. We must work out ways to make our teaching more effective, to increase our educational efficiency, as it were. Reasoning must replace rote learning. The accumulation of facts about science and technology is secondary to the mastery of a scientific method of thinking.

The attainment of professional stature in science and engineering is best achieved through an orientation of mind and habit which begin in early childhood and follow *continuously* through high school and college. The education of future teachers in these fields is an objective of equal importance to that of training scientists and engineers.

We must improve the instruction by reduction of detailed content and by increased emphasis upon fundamental principles and upon the development of powers of judgment and discrimination in the formulation and application of these principles.

I will illustrate what I have in mind with only two of the numerous examples which could be cited. In classical mechanics as well as in the more modern wave mechanics, the principle of conservation of momentum is applicable without known exception. The basic principle is certainly simple. It hardly seems necessary to defer acquaintance with this concept until the senior year in high school. Yet that was my experience, and I believe such is still the case in general. On the other hand, valuable elementary school time is spent in teaching the child about temperature, presumably because he meets this so frequently in everyday life and hence should surely know about it. Actually the concept of temperature, at least its true physical meaning, is much more difficult than momentum. Furthermore, because of its commonplace nature, temperature in the everyday sense is something the child will pick up easily outside of school. Why do we teach children about temperature but not about momentum? I believe the answer to this question lies at the root of the problem. *Our elementary science teachers have not been trained to appreciate what are the truly significant physical concepts.* This is no reflection on them. Rather it is part of the broad problem of the gulf between our professional scientists and engineers and those who have the responsibility of teaching our children.

We need a thorough updating of our textbooks.

They contain too much scientific stuffing and not enough scientific meat. Furthermore, there should be continuity in content from grade to grade. In addition, for each group of textbooks there should be a teacher's companion reference book giving background information and perspective. Otherwise how can we expect our teachers to keep abreast authoritatively on the many new discoveries and developments of the atomic age? Textbook publishers should take more responsibility for providing the teachers with such backup information.

Continuing with the momentum example, this concept would flow into the minds of our students in an unbroken sequence which might go something like this:

Grades 3 - 5—First introduction of idea.

Grades 6 - 8—Simple numerical examples of conservation of linear momentum in collisions with marbles and bouncing balls as examples.

Grades 9 - 10—Two dimensional motion with numerical examples and problems. Extension to angular momentum with spinning tops and the momentum of the earth and of the planets as classical examples.

Grades 11 - 12—Linear and angular momentum as numerical examples in algebra and trigonometry. The momentum of fluids, gyroscopes, atoms, nuclei and light waves would be among the examples.

College 1 - 2—Waves, quanta, relativistic motion, space quantization, atomic and nuclear selection rules. Classical mechanics lead naturally into modern mechanics at this level with the proper preparation.

College 3 - 4—Wave mechanics, quantum electrodynamics, mesic fields, advanced mechanics and general relativity.

In this way we have been able to cover in college much of what is usually reserved for graduate school. However, we have actually expanded rather than telescoped the learning period largely by an early introduction followed by a slow soaking in which is so gradual that the student accepts the concept as one of nature's laws and not as an esoteric educational hurdle. If his technical education ceases at the end of the freshman or sophomore year, he would have a much better understanding of the world around him than is now the case.

Likewise, the conservation of energy could follow a similar pattern. Here we probably would begin with the general principle that like momentum the conservation of energy is applicable without known exception. Then as the understanding of the student gradually increases we would broaden the definition of energy to include the various forms such as heat, chemical, electromagnetic, and mass (nuclear). The introduction to kinetic and potential energy would be a natural part of this subdivision. Likewise, the means of transforming from one kind of energy to another would serve as familiar practical examples. By the time the student had reached the freshman year in college he would be able to understand and appreciate the significance of experiments such as that of Dr. Frederick Reines and Dr. Clyde Cowan, Jr. who recently established experimentally the existence of the neutrino, a particle without electrical charge and with vanishingly small mass. We have known for 20 years that such particles must exist—otherwise our laws of the conservation of momentum and of energy would be violated. But until nuclear reactors were available as a source of neutrinos, it was not possible to measure these elusive little beasties. This brilliant work was supported by the Atomic Energy Commission. It is only one of many examples of fundamental discoveries which have been made under the sponsorship of the AEC.

Needless to say, such discoveries are not made by more than a very small proportion of the scientists needed in this rapidly expanding field. Likewise, not every engineer can come up with a revolutionary development in reactor technology. Still there is a wealth of satisfaction in being a member of a scientific group that is carrying out fundamental research or in being a member of an engineering team that develops, constructs and places in operation a nuclear power plant. Talented people are needed and needed in large numbers for these jobs. We are not producing nearly enough to fill the demand. This is the fifth and final educational problem which I will mention today.

The speech of Admiral Rickover, from which I quoted earlier, was devoted to this problem, "The Education of our Talented Children". He has pointed out that "one half of our children who are endowed with the ability to enter college and university do not do so. For every high school graduate who eventually earns a doctoral degree there are 25 others who have the mental capability to achieve that degree, but do not". Rickover lays much of the blame for this "waste of our most precious national asset" to the fact that with few exceptions the talented children, the top 15 to 20 per cent who are capable of more intensive and more extensive training, "are being taught with the 80 per cent of average and below average mentality". Because the above average child is kept from advancing at the speed appropriate to his ability, he often loses interest in learning and may become a poor student from sheer boredom. I certainly agree with the Admiral's proposals:

a. "We shall not do justice to our talented youth until we seek them out at an early age—no later than 10 or 11—and educate them separately", not necessarily in a separate school but in a college preparatory section of the school;

b. "The schooling must be purely academic, and the teachers must have professional competence in the subjects they teach";

c. "Admission as well as advancement into each higher grade should be by examination";

d. "If possible, the school year should be extended to 210 days", and

e. Industry, together with our educational foundations should set up model secondary schools

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The Special Library

• **By Harold Hughesdon, M.A.,** *(University of Minnesota)*
SUPERVISOR, TECHNICAL INFORMATION, TAPE LABORATORY, MINNESOTA MINING AND MANUFACTURING COMPANY, ST. PAUL, MINN.

The modern industrial research team must have complete, accurate, and up-to-date information. This demand has resulted in the development of special libraries. The special librarian can be considered to be the information officer of the scientific research team.

This article describes the function of the special librarian, his training, and the opportunities open to him.

●

Almost any article relating to careers today bemoans the shortage of manpower in science and engineering. There has been a further recent tendency to point out that the real shortage is of competent manpower, which emphasizes the fact that those of us in scientific fields have an essential task of motivating the able student towards a scientific career.

This motivation is not easy. Science courses have a reputation, usually well deserved, of being difficult, and there appears to be a growing tendency to regard the difficult as evil *per se*. However, some students show unquestionable scientific inclinations, and more could be adequately trained in science with suitable motivation.

Even among scientific workers, there exists a diversity of personality and inclination. We are all familiar with the student who though competent, "just doesn't like lab work". We also know the student, who like Sir James J. Thompson, "was a great experimentalist who was liable to break any apparatus he got near."

There is a particularly suitable area in scientific work today for students in these two categories, and this area also provides an answer for the girl who says there is "no opportunity in science for women". This latter viewpoint, by the way, is unfortunately a statement of fact, insofar as direct competition with men is concerned.

The area in question is delineated by the term "information". It is preferable to use this broader term, rather than the narrower "library", although the library schools are rapidly adopting the newer techniques of information handling as an area in which they should legitimately operate. And it can be argued that the broader term eliminates the traditional, if distorted, concept of a librarian as one who sits behind a desk and stamps books with the date due.

This vocation of handling scientific information usually involves operating in what is known now as a Special Library. Special Libraries differ from the ordinary general library in function—especially in the comprehensive detail of the service rendered — and consequently in material.

The function of a Special Library is usually to serve the information needs of a relatively select group, that is, a group whose main subject interest is in a rather narrow field. This presupposes that the librarian who runs the special library is competent in this narrow field and competence is essential for two reasons. The most important is the fact that without this competence, the information officer or librarian will never be able to find his way around in the field; significant items will have no meaning for him, and far from gaining the respect of those he is trying to serve, he will end up by at best earning their tolerance, at worst, their hostility. Under either of these last conditions, the information groups will be failing in the duties which they are expected to fulfill.

However, in addition to this subject training in the field of specialization, the librarian is expected to be able to solve problems in his own terrain, namely, the handling of information. To accomplish this satisfactorily he needs to be trained adequately in the full background of information-handling techniques and to maintain an interest in them. He needs to possess in some degree that divine attribute which motivates the bringing of order out of chaos, and which has manifested itself through the centuries in the works of designers of arrangements and schemes, whether for books on shelves, or areas of knowledge in their relation to one another.

The opportunities for this science-information hybrid are many. First, there is the prospect of functioning as part of an industrial research team, in which function it is the information officer's duty to make what concrete contributions he can to the research. Industry does not employ information groups for prestige. Real contributions must be forthcoming from the paper worker just as much as from the bench worker. Failing this, the information officer is not doing his job.

Secondly, there is the function of organization and administration. It is the information officer's job to be able to produce information when needed, from the boiling point of an organic compound, to the results of an experiment done five years ago in another division of his company. Not only does he have to produce it on demand, but he has to be in sufficiently close touch with the whole area to know even before the bench chemist what information ought to be a part of the picture.

Thirdly, he must be aware, vitally so, of external information bearing on company interests, whether it is an article in *Fortune* or a Basutoland patent.

In the fourth place, he, unlike the bench chemist, must be prepared to operate outside his field of science specialization. He must be prepared to help in technical writing; to aid in interpreting patents to

(Continued on Page 101)

Paper Strip Chromatography -- *An Art and a Science*

• **By Seemon H. Pines, Ph.D.,** *(University of Illinois)*
MERCK AND COMPANY, DANVILLE, PENNSYLVANIA

Simplicity and versatility characterize paper strip chromatography, a technique which has proven itself to be an excellent research tool.

Teachers of chemistry and biology will find that paper strip chromatography offers many excellent possibilities in the development of new and significant laboratory experiments and student research projects.

●

Along with the increasing complexity of chemistry has come the necessity for newer and more useful techniques to aid laboratory investigation and analysis. Among the developments of recent years has been the technique of paper strip chromatography. The impact of paper strip chromatography on the world of science can be visualized when one considers that Martin and Synge were awarded the Nobel Prize for Science for their discovery of this technique alone.

What is paper strip chromatography? How is it used? Why is it used? The answers to these questions, unfortunately, cannot be expressed in words which are as satisfactory as the results of a successful chromatogram itself.

Paper strip chromatography is a method of separation and purification. Just as some liquids are separated by distillation because of their different vapor pressures, just as some solids are separated by crystallization because of their different solubilities, even more complex mixtures are separated by paper strip chromatography by virtue of their different polarities.

Those mixtures of substances which are not separable by distillation or crystallization, for example, are often readily resolved by paper strip chromatography.

The fact that only microgram quantities of material are required makes paper strip chromatography an exceedingly useful tool for the study of many biological and physiological processes. For example, the metabolism of vitamins, hormones and the action of antibiotics in test animals can be studied by analyzing blood and urinary extracts of those animals after the agent in question has been fed to or injected into the animal. The amino acid content of various proteins can be determined both qualitatively and quantitatively after hydrolysis. The complex mixtures of adrenal steroids can likewise be separated, and in fact have been by means of this technique.

The course of a chemical reaction can be followed by means of paper strip chromatography. Side products can be separated and identified, and the knowledge of their presence often aids the investigator in such a way that he gains better control of his experiments and also a deeper insight into what is happening. The purity of products isolated from complex reactions or natural sources can be ascertained by means of paper strip chromatography. This information offers considerable assistance in devising the best isolation scheme applicable in a given instance.

Separations of inorganic materials, such as the rare earths can also be made utilizing paper strip chromatography.

In addition, milligram quantities of pure materials can be isolated and further characterized by use of modified paper strip techniques. Often no other means of isolation in a pure state is possible.

By the application of rigidly controlled techniques, paper strip chromatography can be used for the development of quantitative assay procedures. A number of such procedures have appeared in the literature, especially in the study of amino acids and steroids. The means used for the quantitative measurement include (a) the size of the spot, (b) elution from the paper and measurement of ultraviolet absorption, (c) direct measurement of visual or ultraviolet color intensity of the spot, (d) size of the zone of inhibition developed by the

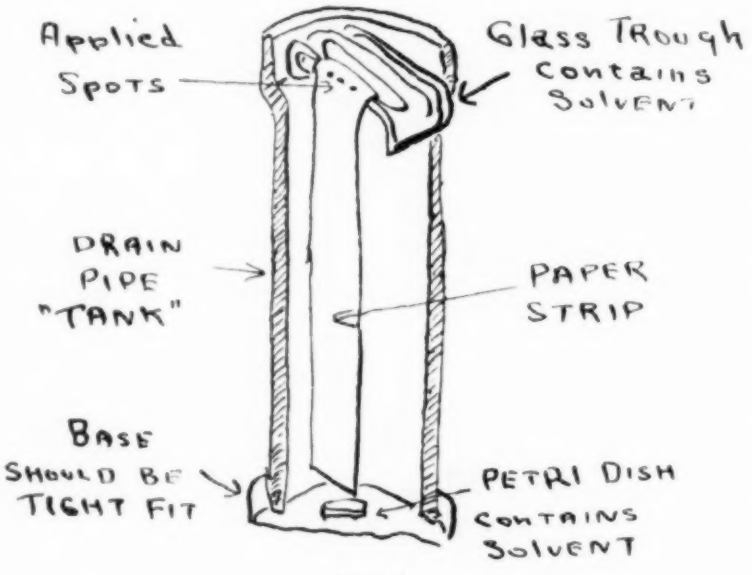

FIGURE 1
Chromatography tank made from drain pipe. Glass cover is not shown.

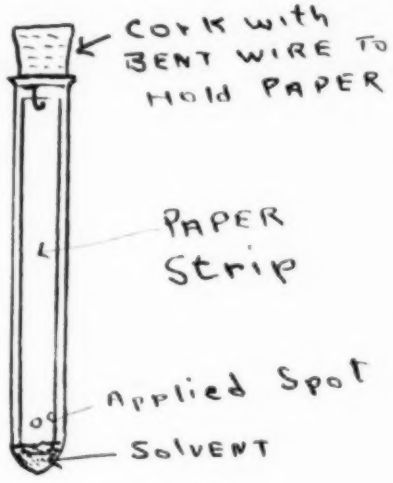

FIGURE II
Test tube chromatography.

spot in a suitable biological medium, and many others. Moreover, the rate of movement of a given compound in a given system is a physical constant of value to the investigator. The ratio of the distance moved by a spot to the distance moved by the solvent front is a reproducible figure and is designated as the "Rf." It is not an absolute criterion of identity any more than a melting point or boiling point of another compound, but is a useful aid to identification.

Some authorities believe that paper strip chromatography is an extension of liquid—liquid partition and that the paper acts only as a support for the solvent. Others claim that adsorption and ion exchange are fundamental principles in operation. For the sake of this description, one can ignore the theory. In practice one is interested in knowing what happens after having learned some of the applications.

All one needs to carry out a paper chromatogram are:

1. paper
2. a container
3. the solvent system
4. a means of locating the spots

Normally common laboratory filter paper (Whatman or Schliecher & Schull [SS]), for example, work quite satisfactorily. Spot resolution is occasionally better on one type than another.

A convenient container can be made by grinding the surface of an earthen crock, and covering it with a sheet of plate glass. The top must fit tightly for satisfactory results (A drain pipe with ground ends also works quite satisfactorily). Figure I is a cut-away sketch of a paper strip tank with the essential parts shown for down flow operation. The tank should contain a trough, usually glass, with its support, and sufficient room for as many paper sheets or strips as desired. In order that the entire vapor space is saturated, a container of the eluting solvent is usually placed in the bottom of the chamber.

Paper strip chromatography can also be carried out in a test tube (up flow, see Figure II). One can be as elaborate as he desires with the equipment.

The solvents of choice will depend upon the type of compounds under investigation. Many systems are described in the literature. Both miscible and immiscible systems are used. The desirable system will (1) resolve mixture, and (2) allow for reasonable spot movement (Rf from .15 to .85). Water-saturated phenol or collidine has been widely used with amino acids, while in the steroid field such combinations as chloroform-methanol/formamide are common. In such a case as the latter, the paper is first treated with methanol/-formamide, the "stationary" phase, then the spot developed with chloroform, the "mobile" phase.

The experienced chemist can alter the solvent system to fit his needs.

If the compounds to be separated are colored, no problems are encountered in locating the spots. If they are colorless, many spot tests, based on the chemical properties are useful. Some of them are: (1) indicators for acids and bases, (2) ninhydrin for amino acids, (3) ammoniacal silver nitrate for reducing substances, (4) potassium iodide-iodine, and many others. Those compounds which absorb ultraviolet light can be located by use of an U.V. scanner.

Colorless compounds can sometimes be converted to colored derivatives prior to chromatography to aid identification.

As previously mentioned, development of zones of inhibition is a technique frequently used to locate such substances as antibiotics.

There are certain techniques that can be described that aid the novice in running paper strip chromatograms. Others are learned by experience.

The substance to be chromatographed is usually applied to the paper in solution. In order to keep the spot small, and hence, the development of it narrow, it is advisable to apply very small drops. This is most readily accomplished by means of a micropipette or syringe. Because the solvent in which the material is applied will tend to spread out, a stream of air or nitrogen applied below the paper will counteract that tendency by hastening evaporation. Figure III shows this technique. If the material can be applied in a very volatile solvent, so much the better.

After the spot has been applied and is dry, the paper is normally sprayed with the developing solvent or stationary phase in two phase systems, and allowed to dry partially. Sometimes it is easier to dip the paper

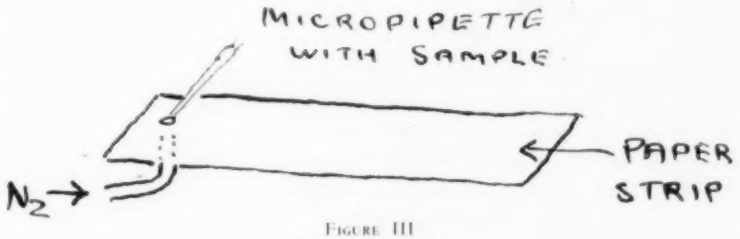

FIGURE III
Applying the spot.

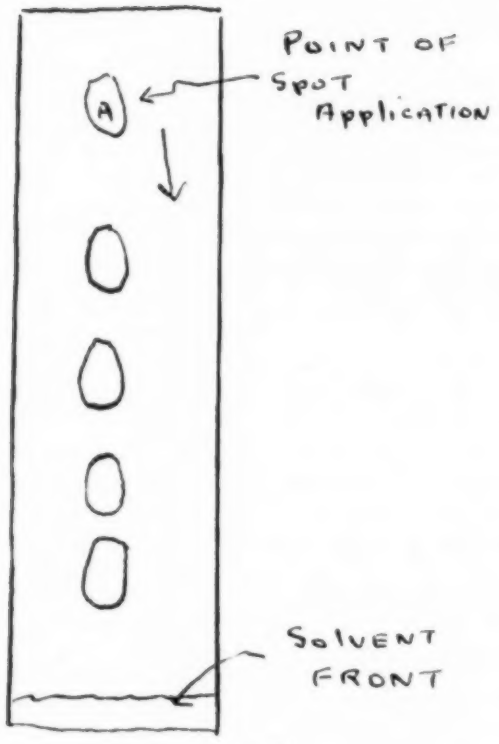

FIGURE IV
Finished chromatogram showing resolution into five spots, one of which (A) exhibits Rf = 0

into a tray of the solvent, being careful that the spot is NOT immersed. This would tend to start moving the material in all directions. If the paper is dipped, the excess solvent can be removed by blotting between two pieces of filter paper.

For downflow chromatography, the paper is hung vertically with the end nearest the spot dipping into the trough containing the mobile phase solvent as shown in Fig. I. Unless the paper is vertical, there is a possibility that the spots will streak along the edge of the paper. For upflow operation the paper is normally held in a clamp with the edge closest to the spot dipping into the solvent. Again, care must be exercised that the spot is NOT immersed.

The chromatographic chamber should be sealed so that an atmosphere of saturated vapor surrounds the paper. Filter paper can absorb up to about 20 per cent water, and this water must come from the developing solvent. If the atmosphere is not saturated with the solvent vapors, this "loss" of water will change the composition of the solvent as it moves over the paper and will make for a poor chromatogram.

Because Rf values can change with changing temperatures, precise work is ordinarily done under carefully controlled temperature conditions.

The solvent front can be seen visually while the chromatography is being carried out. Normally, the development is stopped before the solvent front runs off the paper, so that Rf values can be calculated. The edge of the front should be marked before the paper is allowed to dry. The paper can be dried in an oven, or just by hanging in air. The choice is normally made on the basis of the thermal stability of the compound, or the speed with which one wishes to examine the paper. Suspending paper strips in the fume hood normally found in the laboratory is a quite satisfactory means of drying.

The spots on a finished chromatogram of a colorless substance are usually developed by application of the developers listed above. The developer can be applied as a spray, brushed on, or the paper can be dipped in a tray of the developing agent. Many types of spots will tend to fade with time; however, some can be made permanent by application of "fixes." Some of these are described in the literature.

The operation of paper strip chromatography can be very readily and rapidly demonstrated in the following way:

Place about 3 milliliters of butanol saturated with 1.5 *N* ammonium hydroxide in an 8 in. tube. Apply a drop of phenolphthalein, methyl orange and phenol red to a strip of filter paper about one half inch from the end. Place the paper with the spotted end down (See Fig. II) into the test tube, making sure that the spot is not submerged. Stopper the test tube and clamp it in a vertical position. After about 45 minutes of development the spots will be separated. The top one will be phenolphthalein, the middle methyl orange, and the bottom, or least mobile spot will be phenol red. If these indicators are not available, many others will work. It is possible, however, that two might be chosen with nearly identical Rf values. In this case, separation would not be achieved with that solvent system, and another would have to be devised. The principle of paper strip chromatography can also be demonstrated by use of water as the developing solvent in separating certain inks into their various pigments. ●

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For it is one thing to form and direct the creature from the most profound and ultimate pole of causation, and He Who does this is alone the Creator, God; but it is quite another thing to apply some operation from without in proportion to the power and faculties assigned by Him, so that at this time or that, and in this or that way, the thing created may emerge. All these things, indeed, have originally and primarily already been created in a kind of web of the elements; but they make their appearance when they get the opportunity. For just as mothers are pregnant with their young, so the world itself is pregnant with things that are to come into being, things which are not created in it, except from the highest essence, where nothing either springs up or dies, has a beginning or an end.—*St. Augustine:* DE TRINITATE.

The Medical Technologist with a Liberal Arts Background

• By **William A. Uricchio, Ph.D.,** *(Catholic University of America)*
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This article is from a paper presented at the spring meeting of the Pennsylvania Catholic Round Table of Science at Chestnut Hill College, April 27, 1957.

Doctor Uricchio outlines the services performed by the medical technologist, and discusses the training necessary to prepare one for this new vocation.

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With the increased demands made upon doctors, the continuous advances made in medicine, and the many complexities involved in the newer diagnostic procedures, a new and challenging field has resulted—that of medical technology. Until recently many laboratory tests necessary for the diagnosis of a disease were carried out by the doctor who was sometimes aided by a technician. With the introduction of highly complex tests and the specialized knowledge of complicated equipment, the doctor out of necessity requires the assistance of individuals who are fully trained in the field of medical technology.

Medical technology can be defined as a closely allied branch of pathology, the science concerned with the study of the nature and cause of disease which involves changes in structure and function of the body. The specialist in this phase of medicine who diagnoses the morbid changes in diseased tissues is the pathologist. Under his direction the technologist sets up laboratory equipment, obtains specimens, and performs special tests in search of qualitative and quantitative data necessary for the proper diagnosis of a disease. The technologists' work is not confined to examining specimens alone, but other opportunities are available in various branches of medical research where the search continues for new vaccines, serums, drugs, and antibiotics.

The term technologist is associated with those particular individuals who have completed a recognized program requiring a specified college course previous to their training in the hospital. The laboratory technician or aid, on the other hand, is usually not required to have any formal college courses, but instead obtain their knowledge from on the job training. This hospital training teaches the person methods in performing routine tests, however, it does not usually convey a full understanding of the tests or the field of medical technology as a whole. In many laboratories the laboratory technician is employed to assist the technologist who has had more thorough training which is another point indicating that a difference is recognized among professional groups. In addition, technicians who acquire their skills only from performing routine tests with no previous foundations are usually limited in possibilities for advancement in position and salary.

The requirements for medical technologists are formulated by the American Society of Clinical Pathologists. The present minimum requirements include two years of college with a concentration in science and one full year of training in a hospital approved by the American Society of Clinical Pathologists. After the student has completed this program of study and training she must give evidence that she is sufficiently qualified by passing an examination given by the Registry of Medical Technologists. Upon completing these requirements, the person is allowed to place the letters M.T. after her name indicating that she is a recognized member of the Registry. The title may be made more exacting by using the additional letters M.T.(A.S.C.P.) thus differentiating her from individuals who use the letters M.T. without proper training or authority.

Because of increasing responsibilities and knowledge, the newer trend in medical technology is to require the individual to have a college degree along with the M.T. A person may meet this requirement by attending a college for four years followed by one year in a hospital recognized by the American Society of Clinical Pathologists, or she may attend a college which has an approved medical technology curriculum and which is affiliated with an approved hospital, thus receiving a college degree along with an M.T. The advantage of the latter course is that it can be completed in four years. From the beginning this course has two points in mind: first, to give the individual the necessary liberal arts background and second, to prepare the student in the science foundations upon which the hospital will add the technical and practical training.

The college degree is stressed in preference to merely meeting the minimum requirements for medical technology because it will better prepare one to meet the many challenges which require something more than just technical training. The minimum standards for medical technology are constantly being raised, and the individual with the degree will be better able to meet future competition more successfully. Those individuals who have a college degree in addition to the M.T. are in constant demand and the need far exceeds the supply. In addition they can demand higher salaries and have greater opportunity to advance to supervisory positions where there is a decided increase in pay. To the person with the necessary training, ability, and interest in her work there is offered ample avenues for progress in this new and challenging profession. The program in most colleges is so designed that the student concentrates in the biological sciences and takes a

(Continued on Page 93)

Future Trends in Plastics

• By Richard H. Bruce
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Stop and count the articles in your home that are made from plastics. You will be surprised by the size of the total.

This article discusses the history, uses and future of these versatile materials.

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The Plastics Industry, according to the Paley Commission Report of the estimated percentage of industry growth in the next 25 years, will have by far the greatest percentage of increase. In 25 years, plastics will rank fourth in volume of material consumed each year, topped only by steel, wood and glass.

In the light of past developments this future outlook should not seem too optimistic for materials which little more than a quarter century ago were considered laboratory curiosities. In the past 25 years, consumption of plastics in this country alone has increased more than 100 times—rising from 33 million pounds in 1929 to almost 4 billion in 1955. From a purely statistical standpoint, 4 billion pounds of plastics amounts to an average consumption of at least 15 pounds by every man, woman and child in the present population.

During the decade from 1940 to 1950, the plastics industry grew at a rate more than four times faster than the average for all industry in the United States. During this period of general business growth, the plastics industry upped production year after year by an average of 21.8 per cent per year.

This rapid growth of the plastics industry has, in its course, had profound and lasting effects on the mass production and distribution of goods in our economy. It enhanced national productivity and has thereby raised our standard of living. It has enlarged the base of industry with many new small businesses. It has provided the incentive and stimulus necessary for the expansion of our economy with a continuous array of new and useful products.

To look into the future—this growth of plastics and its effect on economy will continue. How and in what manner can be foretold with a minimum of conjecture—because—

Hardly a day passes without some new modification of a plastic material or a new use for a plastic material being brought to light. Due to the almost infinite capacity for possible variation in plastics, chemical research in this field expands geometrically with each forward step. Each new variation opens potentially huge markets for the application of plastics to industrial processes and consumer products.

To divorce this article, on the future of plastics, from the realm of science fiction, we will approach the subject in three phases; present experience, past experience, and future trends in harmony with present and past experience.

In the first phase, that of present experience, one of the reasons for the growth of plastics, and one which certainly indicates continued growth, is the ease with which plastics are worked and shaped. Because of this, plastics have become ideal materials for mass production. The resultant lower costs have in many instances made possible savings for the consumer and have resulted in greater usage. Without doubt you have noticed that a large number of common, everyday objects now utilize plastics. Toothbrushes, combs, the telephone, the light switch, eyeglass frames and pot handles are only a few of the items mass-produced from plastics.

In another instance, the use of plastics in photographic film and phonograph records has made a wide variety of entertainment, education and pleasure available to everyone. When the mass-produced, unbreakable plastic record supplanted the fragile shellac records, they were a factor in the climbing sales that rejuvenated that industry.

Plastics also find an ever widening market in home building and decorative materials in the home. To mention one item, about one hundred million square feet of styrene plastic wall tile were produced for this purpose last year.

Paints that can be rolled on the wall are based on plastics. By taking the "know-how" out of home painting, these new products have aided the "do-it-yourself" trend in home decoration which has contributed greatly to a whole new marketing technique.

The continuing growth of plastics can also be explained in its expanding use as the hidden or secondary materials of construction in electrical appliances and automobiles. Its use has enabled manufacturers to reduce costs while providing better products. One of the first to accept and make proper use of these materials was the giant electrical industry. Electric power and appliances in conjunction with plastics has made possible for us a labor-saving, push button world of radio, television, refrigeration, washers, switch gear and circuit breakers to name only a few.

The automotive industry has made increasing use of plastics for the safety, comfort and efficient low-cost manufacture of the modern passenger car. The earliest automotive application, the distributor cap, contained less than half a pound of plastic material. Today it is estimated there are more than 15 pounds of plastics in the average car. Safety glass is made

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Life, Health, and Nutrition

• By J. F. Wischhusen
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Ninety million Americans are in substandard health. Many of the common causes of substandard health can be overcome by a more widespread understanding of the principles of the science of nutrition.

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The Origin of Living Matter

The earth in which we live is composed of atoms of which a hundred are now known, and more will no doubt be discovered. Only quite recently science had isolated only ninety-two. The 92nd was Uranium 238. These elements or atoms are composed of:

Negative Electrons
Positive Protons
Neutral Neutrons
Positive Electrons or Positrons

The disintegration of the atom is a science in itself. For Health and Nutrition we are concerned with the combinations of atoms into molecules and molecules into compounds that then form such well known living substances as soil life, plant life, and animal life.

The elements may be roughly divided into two categories, metals and non-metals.

The metals combine roughly with oxygen and this combination is then known as bases, or alkalies.

The non-metals combine readily with hydrogen which combination then forms what are known as acids.

Acids and alkalies form salts, so original chemical matter can be grouped into alkalies, acids and salts.

With time, the aid of sunshine, air (climate) and water the original inorganic matter became organic, and certain of these organic substances develop into protoplasm. Protoplasm is the substance all living things are made of. It is a highly complex chemical matter called proteins. These proteins were created through the ages from inorganic elements of which our planet consists. These inorganic elements, when combined through evolutionary processes of nature characterized by certain stages of organization, become what is then known as organic matter. When organic matter is still further conditioned to a higher degree of organization it becomes living matter.

The transition from inorganic to organic and from organic to living matter is extremely gradual and fluid but there are precise points when inorganic matter ceases to be inorganic and becomes organic and again when organic matter becomes living matter.

The original living protoplasm consisted of proteins which in turn were composed of Amino Acids of which twenty-two are now known to be essential to life. Not all proteins contain all Amino Acids. The Amino Acid constituent of a protein is the key to the protein, and the protein constituents are the key to living matter.

Since the fundamental characteristic of a living cell is life, life is, in this sense, indestructible. The continuation of human life may be endangered by excessive radioactive fallout.

All processes taking place in the living cell are of a chemical nature and involve a carefully controlled acid—base equilibrium. Cell growth starts in an acid phase, and the acidity diminishes progressively with its growth until the cell reaches its prescribed limit in growth. Then the cell is an alkaline phase. Then it synthesises out of its own materials a chemical compound known as glutathione. Glutathione is a protein substance composed of three Amino Acids, glycine, cysteine, and glutamic acid. This is synthesised in the growing cell in both the SH (Sulfur Hydrogen) and the SS (di Sulphide) forms.

The human body is governed and administered as an autocratic dictatorship. The individual cells have no voice in government. When a government either civil or biological is misgoverned for any length of time then rebellion and anarchy arise.

Such is the case from a wrong or unbalanced supply of nutrients that is called a deficient or excessive food supply. Imagine the confusion that would result from teaching or accepting that 2×2 equals 5. Such is now the case with all the arts of nutrition, cosmetics, medicine. If these were correct sciences, most of the reactions would have to perform in reverse.

When the wrong facts are in textbooks and used as true facts, the student and teacher are headed for disappointments and trouble based on misconceptions. It behooves everyone to study the science of biology and food metabolism if we are to enjoy good health.

On the Causes of Health

As is the case with our financial system when all goes well nobody is interested in investigating the causes thereof, so it is with our bodily health: we are little concerned with the causes, and scarcely anyone will venture a rational discourse on the *Causes of Good Health*. As soon as some part of our anatomy shows signs of disorder, is tired, dispirited, or definitely sick, all kinds of advice is forthcoming about the *Causes of Poor Health*.

Yet implicit in any attempt to diagnose what ails us, is the principle that prior to the appearance of signs of ill health we must have enjoyed conditions of good health. These then were taken for granted.

This brings to mind the reactions of the ancients in the face of physical ailments. Among their contemporaries not even the most learned and respected prac-

titioners could explain Good Health, except that it was enjoyed only by the grace of the gods. Good Health was vaguely described by the early Greek Ascolepians as a state in which the various elements of the body were in a kind of Pythagorean harmony with each other. Or that the four "humours" were in approximate equilibrium. Neither the patient nor his "Doctor" knew anything, for example of the circulatory system whereby body tissue is maintained. They had no conceptions of the nervous system of internal communication and motivation. And it was a matter of long dispute whether thoughts and emotions were generated in the head or the chest. In view of such ignorance it is not surprising that the simplest diseases called for the most grotesque and preposterous remedy imaginable. The Demons which were causing the discomfort could be excorcised only by swallowing a repulsive concoction. In addition to irrational medication, magic incantations were also believed to be essential. The "spirits" which were unquestionably provoking lumbago, headache, or fever, presumably were susceptible to audible persuasion.

Why did virtually everyone accept these incongruous methods? Partly because of confidence. Then even as today, it was of considerable comfort and relief to know that something "constructive" was being done, even if it meant a diet of Raw Dolphin Livers until the misery subsided. Cures are almost infinite in variety and explained with great scientific words, in great earnestness, and with conviction, but the *Cause* of Health remains obscure.

The causes of our economic Health may well be explained with the profit motive of activities. When profits are pyramided and not re-employed in more production of goods for consumption there sets in a reaction, a slump, followed by another recovery.

But in body health a reaction to a period of uninterrupted good health for reasons that are not understood, may prove fatal. The man who dies at 40 of heart attack whether on a golf course or in his sleep does not know why, and his relatives do as a rule not find out more than the immediate cause of Death—a "heart attack." All of us die of a heart attack; when the heart stops man is dead. So heart attack, or heart disease, heart stoppage, is the universal cause of Death. But it would be ridiculous to consider the heart the sole problem.

Nutrition Is the Chemistry of Life

Fortunately the science of Nutrition is coming to the forefront, and there is now a general awareness that Health principally enters by way of Mouth. Disease therefore can be prevented by how people eat, assimilate and utilize their food. This places the responsibility of adult health upon the individual, that of children upon the parents, and that of the unborn generation upon our women from the time shortly before child bearing age until child bearing age is past. Inadequate maternal nutrition can lead to many forms of deformities in the offspring. Hare lips, cleft palate, misshapen limbs and other congenital deformities can be produced by dietary deficiencies, but also be prevented by diets adequate in all essential nutritional factors found in unrefined foodstuffs of vegetable, animal, marine, mineral, and atmospheric origins. To the extent natural foodstuffs have been processed, refined, sterilized, concentrated, and treated with preservatives, the addition of the essential nutrients that were originally present become daily requirements in the way of dietary supplements of minerals, vitamins, amino acids, unsaturated fats, etc.

Nutrition problems deal with undernutrition (as distinct from deficiencies due to the deliberate removal of nutrients through refining of foodstuffs), malnutrition, and overnutrition. Coronary heart disease, serum cholesterol, atherosclerosis, and other so-called degenerative disorders are all affected by diet for either good or bad. Non-dietary factors may play a contributing role, such as for instance smoking, emotional tension, and exercise. Non-nutrient substances in foods, intentional additives such as canning preservatives, additives to improve texture and appearance, coal tar dyes, bleaching agents may likewise play a contributing role. Man and all mammals are dependent on their commensal intestinal flora for the digestion of cellulose, synthesis of vitamins, protection from invasion of the gastrointestinal tract by pathogenic micro-organisms. The effect of commensal organisms may be threefold upon growth, viz: upon appetite, upon the destruction of organisms which compete with the body for certain essential nutrients, and upon the destruction or promotion of organisms which synthesise nutrients required by the body.

In the interest of his health man must study nutrition, the Chemistry of Life. Progress of civilization so far is balanced by progress also of disease, so that out of a population of 170 million people, something like 90 million are in substandard health. What is more natural than for these 90 million to study the advantages enjoyed by their 80 million contemporaries who are in robust health? Man's intellectual curiosity gave birth to the exact sciences and made possible his efforts to escape from a purely agrarian existence. The duty of modern living is the acquisition of optimum health. Food metabolism also is governed by the principles of an exact science: Biology, which can be studied and applied for that purpose.

The nutrient requirements by humans for optimum health have of course been, and will forever remain unchanged, so the problem is merely a supply of those nutrients under proper surroundings. The sources of nurients are immaterial. But as the sources of foods and their compositions constantly differ for any one of many reasons, so must various food supplements be designed and used to balance the total diet. ●

The Undergraduate Seminar in a Small Chemistry Department

• By **James W. Hackett, O.P., Ph.D.,** *(Yale University)*
PROFESSOR AND HEAD, DEPARTMENT OF CHEMISTRY, PROVIDENCE COLLEGE, PROVIDENCE, RHODE ISLAND

Undergraduate seminars can be used to develop a professional attitude in the student, and to introduce him to the use of chemical literature.

Father Hackett discusses the undergraduate seminar program, followed in Providence College, and reveals some of its unexpected by-products.

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Schaap and Day[1] have recently considered the undergraduate seminar as a solution to the problem of providing close contact between the undergraduate chemistry students and the chemistry faculty in the large college or university. This problem is non-existent in a small college. Our chemistry majors at some time during their four college years study under every member of the department, both in the classroom and the laboratory. Staff research and individual professional interests become well known to the students through such close association, and informal consulting about current difficulties, future opportunities, etc. is ordinary and continuous.

Earlier articles by Sampey[2] and Sister M. Ignatia[3] and Fromm[4] have described undergraduate chemistry seminars in small colleges which fulfilled specialized objectives. The present author will attempt to fill out the picture by presenting the undergraduate seminar as it has been developed in a small college from more generally applicable principles.

Objectives

Our aim in establishing the chemistry seminar was to broaden the scientific knowledge and aspirations of the undergraduate by introducing him to topics not covered in his regular courses. The work of contemporary investigators as reported in the journals would be presented by the student-speaker to his fellow students, and in the preparation for his talk he would gain practical experience in the use of the literature of chemistry. The seminar was intended also to provide opportunity for public speaking—a lab course in verbal expression of his chemical knowledge, formal in presentation, informal in the subsequent discussion. We found that many by-products of the seminar program were equally valuable as the ones primarily intended.

Organization

Seminars are held once a week at a time scheduled to introduce the minimum inconvenience for student attendance. Senior and junior chemistry majors are required to attend; sophomores and freshmen are invited, as well as students from other concentrations. The chemistry faculty are faithful in attendance, and frequently members of other faculties sit in.

Soon after classes start in September a list of seminar dates is posted, the seminars to begin by mid-October. Volunteers are solicited to open the seminar season; the remainder of the dates are assigned. Some students will have been working on their talk during the summer, and so are prepared to give their seminars early in the academic year. Seniors present the fall semester talks, and juniors the spring semester. Thus the group newly participating each year are exposed to a term of second-round speakers before they give their first seminars. By way of remote preparation, the sophomore chemistry majors are required to give ten-minute talks in class on some phase of analytical chemistry.

The seminar talks are required to be about thirty minutes. They may be extended somewhat, but they may not be less than twenty minutes. (Only once was a student required to give an additional seminar because of his failure to go minimum time, while three students have had to present another seminar because of inadequate preparation.) Discussion usually fills out the hour. Professors are ready to prime the question period, but such stimuli are found unnecessary after the better seminars and seldom needed even for the ordinary ones. Silence after a talk is mute testimony of an unsatisfactory verdict passed on the speaker's efforts by his classmates. One of the faculty members offers privately to the speaker a critical analysis of his talk. After the student's second seminar, a comparison of the two is made, noting the improvements and indicating where further effort should be applied to strengthen speaking ability.

Subject Matter

Topics for seminars are limited only by the broadest concept of chemistry—pure, applied, theoretical, descriptive. The only restriction is that the subject be either something not covered in the scheduled undergraduate courses, or that it be a more complete treatment of a familiar theme. The topic is chosen by the student, subject to any faculty member's approval. Most undergraduates need a little help in looking for a suitable topic, but no student is ever assigned a specific talk. Too much time should not be spent on the search for a topic. It has been found necessary to remind some topic-searchers that they are not expected to understand the subtilities of the subject of their talk at this point; only that, with diligent application, they can master it. The occasional poorly prepared seminar and subsequent discussion-time embarassment are grim warnings of what can happen if the subject matter is not thoroughly assimilated.

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The Balance of the Indian Problem

• **By Magda De Spur, Ph.D.,** *(University of Budapest)*
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The American Indian has made many significant contributions to our way of life, and has received little in return.

The author of this article has taught modern languages and the history of art. While Hungarian born, she has acquired an interest in Indian art and Indian problems.

I.

As the "Invaders" See It . . .

What Indians Gave

Although it has been admitted that many of the cultural elements that helped to make America what it is today are Indian, Indian culture remains misunderstood and underestimated. Four-sevenths of our American farm products consist of plants domesticated by Indian botanists of pre-Columbian times, methods of planting, irrigation, cultivation, storage and utilization were also acquired by settlers from the Indians. In four hundred years botanists and physicians have not discovered any medicinal herb unknown to the Indians. The social and cultural significance of such material contributions is certainly impressive. Indian methods of child training have caught the attention of psychiatrists. Indian jurisprudence has been studied and appreciated by anthropologists and legislators.

A better understanding of Indian problems would help to diminish themes of pity and superiority of the white man, and to bring about a humane policy by fulfilling Indian desires to achieve a higher standard of living and still maintain ethnic identity.

What Indians Received

Since 1832 the Indian tribes were political bodies with powers of self-government. *The Bureau of Indian Affairs* (IB) was founded to protect Indians from oppression and extermination by local, that is, State interests. The Indian Bureau gave them services, not as a gift, but in recompense for lands sold to the U.S. at 800 million dollars. Federal Indian property-law recognizes that Indians held their lands prior to and maintained title to them subsequent to the discovery of this continent. Federal relations with the Indians were handled as part of international relations. However, methods to recover instructions on Indian lands were only provided since the creation of the Indian Claims

Culture Areas and Approximate Location of American Indian Tribes Today (originally published by the Indian Arts and Crafts Board)

Commission in 1946, these enabled tribes to present their claims against the United States. Tribes have collected millions of dollars through these procedures and as a result were able to regroup their members and to survive as ethnic groups.

By the Act of Congress in 1924 all Indians born in the U. S. were declared citizens, in practice, however, they were subject to the abuses of discrimination and to limitations of economic and social conditions. Until 1948 they were not allowed to vote.

Federal Policy: assimilation

To most Indians the "Reservation" is all that stands between him and the spiritual and physical destruction undergone by most non-reservation tribes. After the Civil War the general federal policy was Indian assimilation, which resulted in the acquiring of Indian lands by white farmers. The reservations were divided into 160 acres per family, the remaining land was to be sold to white settlers, and the money deposited in the U. S. Treasury to the credit of the tribe. By 1933, about 910 million acres passed from Indian to white-ownership. On the allotted reservations the white holdings had the water-rights. Tribal leaders who would not serve as puppets of the IB were stripped of all authority. Indian children were placed in boarding schools, where native languages and customs were excluded. On the part of the Indians who attempted to comply with these demands and still avoid assimilation, some superficial aspects of white culture were accepted.

The Indian Reorganization Act

In 1934 a new philosophy halted the tribal destruction, and promoted the regeneration of Indian culture and thereby Indian well-being. Fundamental principles of this program were the preservation of the land base, tribal self-government, the elimination of legal restrictions, credit funds to develop tribal economy, useful education for the Indian children and adults, cultural and religious liberty. The Indian Reorganization Act was the first step in treating ethnic minorities.

An Undesired Change In Methods

From 1950 to 1953 the opinion of those who considered Indian "isolation and non-assimilation" harmful to the goal of the Indian adjustment became prevalent. The Indian Bureau established a new policy characterized by an almost systematic interference with tribal and personal rights, customs, religions, and the use of property, and which neglected arbitrarily any consultation with the tribes as regards policies or legislation about their own welfare. It was remembered by some as the erosion of Indian rights.

The Present Status of the Indians

Today, the American Indian is at the bottom of the income ladder. The average family income from agriculture is about $730 yearly, from other sources about $855 yearly. Their land area is 56 million acres, and out of 400,000 Indians about 100,000 are still landless. Proportionately during 1953, the Indians had twenty times as many deaths from measles, nine times as many from tuberculosis, four times as many from pneumonia and influenza, three times as many infant deaths than had the non-Indian population. The school enrollment of Indian children has been increasing recently, but there is a low percentage of high school graduates and few college students. The school days are short, the quality of teaching is inferior and many children are not enrolled at all. The greatest dilemma of the Indians is that they feel that they are hovering between two worlds. The dissolution of traditional systems of social control without the acquisition of the equivalent structures of "white society" has produced a condition of social disorganization resulting in "disorderly" behavior on and off the reservations.

The Indians when settled outside the reservations, and cut off from their traditions, are torn between the psychic satisfaction of the old culture and the material comforts of modern life. Educated Indians are seldom received on terms of social equality and learn to expect employment inequality. Rejected by the white world, some go back to the reservation or they abandon all moral codes, still others achieve a flat and empty adjustment. In politics, they are apathetic due to their frustration in the economic field. Unfamiliar with modern business practices and lacking capital, their inhibition is still growing. The creation of employment openings, the development of self-government without the paternalism of the Indian Bureau should be the first concern. The off-reservation Indians (approximately 100,000) are settled mostly in the slum districts of some towns, and are affected by exploitation and discrimination.

Relocation—Termination

In 1953, the Federal Policy changed again. The slogan for the revised methods of the solution of the Indian problems were: a) voluntary relocation of the Indians to the major cities, b) termination of Federal responsibilities for Indian tribes by transferring the "services" of the Federal government to the States, cancelling the provisions for tribal self-government and distributing tribal money on a per capita basis.

At the Ceremonial Seminar (Gallup, New Mexico, 1956) Mr. Glenn Emmons, Commissioner of the Indian Bureau since 1953, displayed the "Programs for Indian Progress". He emphasized that the number of Indians in the U. S. has increased from 250,000 to 400,000. His program included an enlarged preventative procedure transferring Indian health responsibilities to the Public Health Service, the enrollment of *all children* in schools and voluntary relocation of Indians. He saw the benefits of such measures in the broadening of the opportunities for economic advancement and in the easing of the population pressures on the limited resources of the reservations. The most important part of this program has been the separation of the Indians from Federal controls, trusteeship and laws, giving them an unrestricted control over their property and full responsibility to manage their tribal and individual affairs either through a corporative body under the state law or through a private trustee. Of course, the concept started from the presupposition that the trust-relationship is no longer needed.

II.
The Indian Angle

The Intertribal Meeting in Gallup, N. Mex., 1956

The representatives of all tribes were "honored guests" at the Ceremonial Seminar arranged by the Indian Bureau. Their own meeting, the conference of the All Pueblo Council and of the Arizona Inter-Tribal Council, followed the Seminar of the Indian Bureau for two days. The policy of relocation and termination had been thoroughly debated. All addresses clearly reflect the standpoint of the Indians of today, concerning both issues. The "termination" of the trustee status of the Indian land would mean leaving Indians homeless, hopeless and destitute, and place them on the property tax-roll. They would be tempted to alienate their share of tribal lands by the cash offerings of the white man. And once the Indian becomes landless, thrown into a strange culture, how could he acquire, with his given inhibitions, an adequate livelihood? The "relocation" program leads the Indian to the agencies of the large cities which are not doing an adequate job for them. They "place" the Indian and then forget about him. Too often aged, physically handicapped and uncultured Indians have been unhappily relocated. They are often bitterly disillusioned and return to the reservations. The Indian Bureau is building up the relocation, regardless of the reservation economy, and using its funds to finance relocation. In 1954, the cost of the relocation of about 2500 Indians amounted to $600,000. The drafting of comprehensive rehabilitation programs in which there is the only hope for Indian welfare, has been unwisely delegated by the Indian Bureau to a non-profit corporation, which must secure the necessary funds from private foundations. The Inter-Tribal Meeting, in summing up the objections to an inadequately prepared program, stressed all Indians' desire for a vigorous plan of reservation development where acculturation comes gradually, and the frustrations of maladjustments are minimized.

The Work of the National Congress of American Indians (NCAI)

The NCAI was founded in Denver, Colorado, in 1944, with 100 individual Indians. It represents at present more than 150,000 Indians. This organization has recently presented to Congress a positive program for Indian rehabilitation. The American Indian Development Program submitted by the NCAI is an attempt by the Indians themselves to stimulate community interest, leadership and self-reliance through the workshop method.

The Real Indian Issues

Indian leaders recognize that Federal responsibility must end some time. But Indians are still unprepared to enter an aggressive competitive white society. Federal programs have failed over the years. There is no excuse for abandoning the Indian today. Federal responsibility should end only when the Indian will be strong enough to hold on and assume the entire burden formerly provided by the government. Consequently the real issues of the American Indian are not assimilation, integration, emancipation of Government control, but as Mr. Clarence Wesley, a San Carlos Apache, Vice-president of the National Congress of American Indians, very comprehensively stated it: "a) ownership of land, b) development of resources, c) protection of rights, d) day in court for Indian claims, e) the same opportunity of education of the same quality as is available to non-Indian citizens, f) adequate Federal assistance, g) end to bureaucratic dictatorship, h) minimum interference and maximum assistance to help Indians."

"Indian tribes", stated Mr. Wesley, "need the kind of program that this Nation is making possible in under developed countries in other parts of the world. Money and political power are needed to protect what little is left of our once great natural resources. Modern tribal business corporations, healthy and prosperous communities are our goal. The greed of the invaders has taken our wealth from us. We have left only our political power with which to improve our conditions."

III.
Charity or Asset?

The Indian of the United States does not pose any more threats to the security of the country. He is no longer a competitor in economic life. On the other hand "helping Indians" will not pay in the sense that foreign aid "pays". Those who are struggling to better the Indian's livelihood, stress the moral obligation which must be based on the humanitarian principles of our democratic community. Facing such manifestation of "good will", there are still a few questions to be asked. Why not try looking at the Indians from the angle of their own specific culture, psychology, morals and talents? Why do we want to mold them to the whiteman's pattern? Why don't we aim to make them an asset for American Culture? Are we not conscious of the fact that Indians are born artists? They have been weavers, potters, silversmiths from the olden times on. They have shown their acting talents quite recently at the nightly performances at Gallup, New Mexico. They offer intricate rhythms and evocative tones of scales in their genuine tunes. They are deep, symbolic, and colorful in their poetry. The greatest surprise of modern times is that they are outstanding painters. With the tools of the white civilization in their hands, they have been creating in their quiet, meditative way a new symbolic, impersonal, selectively, stylized, abstract art. This art is unlike the European influenced art. It is unrepresentational, revealing a keen observation and knowledge of nature.

Should such art not play a vital role in the aesthetic development of the U. S.? In fact, the Art Section of the Indian Bureau under the leadership of Mr. J. Edward Davis, encourages it. Mr. James Watson, head of the Department of the U. S. Indian School of Santa Fe, a native of Pennsylvania, points with admiration to Indian paintings done without models, taking the subjects from mere imagination.

Mrs. Dorothy Dunn, founder (1934) of the School of Painting of the United States Indian School, came

(Continued on Page 96)

Atomic Energy

(Continued from Page 80)

(5th grade and above) which would be free but which would require passing entrance examinations designed to select only the talented for specialized training and preparation for entry in college at age 16 or earlier.

In summary, I consider the five major educational problems to be:

1. The complexity of our culture is increasing faster than the efficiency of our education,
2. The number of trained teachers is decreasing at an alarming rate,
3. Language barriers impede our international communication of ideas,
4. There is too much emphasis on factual knowledge and not enough educational effort on conceptual understanding, and
5. Our educational system neglects the talented in favor of the average.

There are undoubtedly other big educational problems, but these five seem foremost to me. In formulating plans for the future of technical education at the University of Puerto Rico, I am sure your leaders in government, industry and education are aware of these problems. The Atomic Energy Commission and its laboratories stand ready to help them and you in every way that we can to build a Spanish speaking technical education center which will be a model for all the world to admire and to emulate. ●

★ ★ ★ ★ ★

The Medical Technologist

(Continued from Page 85)

minor course in chemistry which allows ample opportunity to pursue electives in subjects of her own choosing. After completing three years of college work, the student has a balanced liberal arts background along with the necessary prerequisites in science. The last year of the program is spent at the hospital where the student is required to spend forty hours a week for fifty weeks at which time she receives additional lectures and practical experience, all so necessary for the full development of the individual engaged in this profession.

Medical technology is one of the fields in which women predominate, and one that is rewarding in providing a service to people. This is a fast growing profession that offers one the opportunity to grow with her work probably more readily than in long established professions. ●

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Future Trends in Plastics

(Continued from Page 86)

with an invisible layer of vinyl. The phenolic adhesive element in brake linings assures quicker and safer stops. Instrument panels, rear light reflectors, and lenses, upholstery, electrical wiring insulation, weather stripping and the auto body itself (in some cases) are but a few of the many automotive parts made of plastics. In addition, the automotive industry consumes large quantities of plastics in its manufacturing processes with the use of plastic tools, dies, and jigs.

The foundry industry took a step forward with the aid of plastics. By bonding sand in a thin shell with phenolic resin, a way has been found to mechanize the foundry so that it can cast metal faster, cleaner, more accurately and at lower unit cost. At the same time, in contrast to the age old foundry industry, the ultra-modern electronics industry encapsulates transistors and delicate tube assemblies in plastics to protect and insulate them.

One can hardly escape the evidence of the present day expansion and upward curve of plastics in general. But in the event we "cannot see the tree for the forest" perhaps a brief discussion of the rise of one particular plastic might be apropos in presenting the second phase (past experience) of our subject.

This plastic material, which is expected by the industry to be the "first billion pound plastic" is polyethylene.

The rapid introduction of this material into our everyday life has made us aware of its importance through recognition of the part it plays; in improving the quality of goods obtainable in polyethylene packages, the more durable and economical housewares now available, better moisture proofing in housing, improved irrigation facilities, flexible cold water pipe and a variety of other items in everyday use.

The story of polyethylene started in 1944; its first full year of production. From that time until 1948 the total output of this material remained fairly constant—about 15 million pounds. Even with this small amount there was some concern as to whether the total production would find a market.

In 1948 additional production facilities were added so that during the first ten years of manufacture, polyethylene production rose from one to 150 million pounds annually. In the last two years it has expanded another 200 million pounds.

To speculate on the future expansion of this material would be somewhat anti-climatical in regard to our topic. These figures were presented merely as an example of past performance indicative of future possibilities.

This brings us to the third phase (future trends.) Up to this point we have discussed the popular present day approval of plastic materials — this is likely to increase the tendency towards optimistic estimates for the future. The expansion of polyethylene has been rapid and uniform and also suggests extremely large future production. An estimate of future plastic production in harmony with the present and past performance of plastics certainly indicates growth in the future—but—

When thinking of the future of plastics, we are not only concerned with the development of entirely new types of synthetic materials. We are concerned as well with improvements on—and new applications for—existing materials. Production capacity, price trends, factors influencing expansion of sales all add meaning to the picture of the future. To go into all these variables would perhaps be slightly overburdening for our topic.

To be more concrete let us enumerate some of the material which has entered the industrial scene or will be introduced in the near future.

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Resins for Low-Pressure Molding . . . . . phenolics, polyesters, epoxies.

These are but a few . . . . .

The panoply of plastic products, as yet undiscovered, which will find application in markets, as yet undefined, are as much dependent on a crystal ball as on availiable statistics and technical experience.

The plastics industry will grow. Its history was interesting . . . . . its future should promise excitement. ●

★ ★ ★ ★ ★

GEOMETRY

The science of geometry is said to have been discovered first by the Egyptians, because when the Nile overflowed and all their lands were overspread with mud, its origin in the division of the land by lines and measurements gave the name to the art. Later, being carried further by the keenness of philosophers, it measured the spaces of the seas, the heavens, and the air.—*St. Isidore.*

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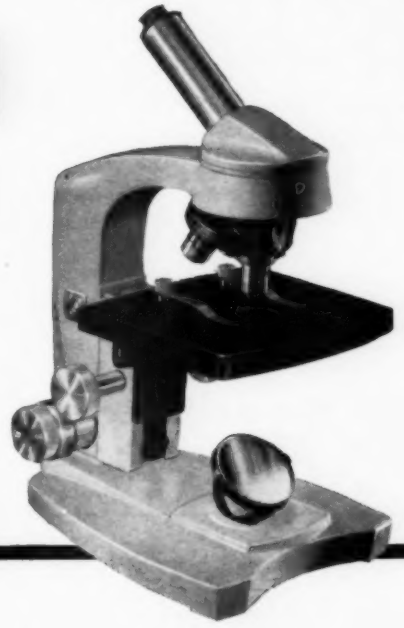

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The Indian Problem

(Continued from Page 92)

to the following conclusion concerning the significance of Indian painting: "It is inherently and uniquely American! It offers unlimited enrichment to the fine arts in every field and like any serious painting to the ethnological and historical record." *(The National Geographical Magazine*, March 1955). "Now belatedly we realize that the Indian is an artist. We see his art rising higher and higher in world recognition and welcome it as our own. It is the original art of our Nation." *(Ceremonial Magazine*, 1956.)

In the course of last year, 19 different places in Europe had asked for Indian material from the Museum of Modern Art, New York City. This native, indigenous "school of American painting", not aboriginal in the primitive sense, but modern and contempory, successfully attracts the world interest toward the American Indian. His art is a positive and promising asset for the future, and it seems to point to the right way of settling the Indian problem . . . with willingness and due understanding for his specific angles deriving from his traditional aspects of life and morals, with discriminative appreciation of all his qualities, his innate talents . . .

No, the Indian does not want charity. Conscious of his qualities, that is, the asset they represent for the country, he is waiting patiently for the Nation to get around to a similar program with the indigenous "minority", as Congress has enacted for some underdeveloped countries in other parts of the world. Is it not a legitimate desire on his part? ●

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NSTA to Spotlight Elementary School Science

WASHINGTON, D. C.—Young scholars will soon be getting a bigger and better helping of science as the National Science Teachers Association (NSTA) steps up its services to elementary school teachers.

NSTA, a department of the National Education Association, will move to aid the teachers in three ways. (1) Its present publication, *The Elementary School Science Bulletin*, will be twice as large and be issued eight times a year. (2) A part-time specialist in elementary science has joined the staff as a consultant and editor. (3) NSTA's three conferences for the coming year will emphasize science in the grade schools.

"Elementary school teachers can't be specialists in science, but NSTA aims to make them more secure in their knowledge of the field," commented Robert H. Carleton, NSTA executive secretary. "The textbooks teachers work with are excellent, but they are asking for more help in relating science to the present curriculum and to other subjects. We will try to meet this need."

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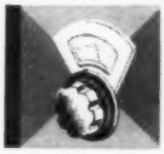

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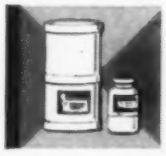

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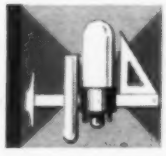

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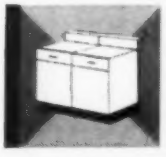

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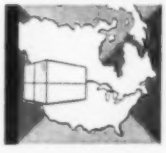

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NSTA's push in the elementary grades comes in a year when, for the first time, an elementary educator is the organization's president. He is Glenn O. Blough, Associate Professor of Education at the University of Maryland. Dr. Blough has written science methods books and science stories for children.

The revised NSTA Elementary School Science Bulletin will be off the presses in October as a two-color, 8-page publication. It will appear monthly through May, with subscriptions priced at $1 annually per individual and 50¢ each for school groups of five or more persons.

Dr. Dorothy Alfke has joined NSTA headquarters staff on a part-time basis and will serve as co-editor of the new Bulletin with Dr. Carleton and as a field consultant. Miss Alfke is a professor at the College of Education at Pennsylvania State University and received her doctorate from Cornell University in elementary science and nature education.

Science in the elementary grades will come in for major discussion at two NSTA regional meetings, scheduled in Hartford, Conn., October 18-19, and in Indianapolis, Ind., December 27-30. The national convention in Denver, Colo., March 26-29, will be preceded by a one-day conference for elementary supervisors. ●

★ ★ ★ ★ ★

New Motion Picture

Assignment—Weights and Measures, a film of the National Conference on Weights and Measures, produced through the cooperation of the National Bureau of Standards; color and sound, running time 18 minutes. Prepared for the non-technical audience, this film tells the story of how weights and measures supervision affects the average American family. (For information about the loan or purchase of this film, write to the Secretary, National Conference on Weights and Measures, National Bureau of Standards, Washington 25, D. C.)

The film opens in an elementary-school class which is studying various aspects of Government. On this particular Friday afternoon the teacher gives out the homework assignment — weights and measures; the children are to report as many instances as they can find in which commercial weighing or measuring touches the lives of their families. The film follows the experiences of Bobby Clark as he goes about on his own to complete this assignment, and as he and his classmates listen later on to talks by the teacher and watch a motion picture shown in the classroom by the local sealer of weights and measures.

A simple but sprightly story is told. The audience sees familiar neighborhood scenes, but also gets glimpses of some interesting backgrounds—some of the things that an inspector of weights and measures does, where his standards come from, and the role of weights and measures from corn to corn flakes, from the dairy cow to the milk bottle, from livestock to the roast of beef. ●

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The Undergraduate Seminar

(Continued from Page 89)

Some of the fruitful first sources have been Chemical Reviews, Quarterly Reviews, Endeavour, Scientific Monthly, Journal of Chemical Education, etc., and from these leads the original literature is searched for fuller treatment and data. Several seminar topics have developed from a teacher's off-hand remark in class about a controversial formula, such as the ferric thiocyanate ion, the problem of electrolytes of intermediate strength, etc. Students working part-time in industry or those with hobbies have followed these interests through to formal talks on the chemistry behind them. Senior research projects can develop from interests aroused by seminar preparation but have not been reported as seminars, since senior research is hardly under way the first semester. In a few cases, seminar topics have directed the students' interest into areas of study that have qualified their choice of graduate school and have become their graduate research projects.

The Summary

When we first began the undergraduate seminars, the speaker was expected to prepare and hand in a week in advance a detailed outline of his talk. Several years ago we changed this requirement to a 200-300 word summary of the seminar with a list of the principal sources of his information. These summaries are checked carefully for clarity and exactitude of expression, spelling, correct usage of common and technical words and abbreviations, etc. Practically every summary has to be revised or rewritten to improve the content or the style. A common difficulty is the tendency to write an introduction to the topic rather than a resume of the whole talk. Sometimes a vagueness in understanding which can be remedied before the talk is discovered in the criticism of the summary. The importance of precise expression and the permanence of the written word are stressed as justification for the time and care lavished on the summary.

These summaries are run off on a duplicator, and copies are posted in advance of the talk on the official bulletin board and throughout the chemistry laboratories. This innocuous publicity increases the sense of responsibility in the student-speaker even though occasion may be taken for some good-natured ribbing by his classmates. Copies are furnished to those in attendance.

By-products

Since each junior and senior gives one seminar a year, the time devoted to it is not excessive even if it is considerable. While prepared slides haven't yet found their way into our seminars, carefully drawn blackboard diagrams and tables of data are commonplace. Opaque projections and demonstrations also have been used. Samples and models have been incorporated with the casual nonchalance of the veteran tour-speaker. Faculty habits, both good and bad, have been imitated. Talent, occasionally hidden in the class room, has been recognized. The staff have found in the seminar a point worth making in giving recommendation to graduate schools or for industrial placement.

Out of the undergraduate seminar there has grown a student publication, first mimeographed and now printed in off-set. While the idea is to publish the best of the talks, more realistic is the admission that often it is the persistence of the author in revising and reducing his manuscript to the satisfaction of the editor that is rewarded by publication.

Appraisal

From the very beginning of the seminar program, the students have taken to their talks with a truly pro-

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fessional spirit. Many pick their subjects a semester or more in advance. The science library is busier than it ever was. No academic credit is given for the seminar, no grade is assigned, nor does it count toward any course grade. It is listed in the college bulletin as required of chemistry majors. It is a matter of personal pride.

Leaving the hall after a seminar several years ago, I overheard one professor remark to a colleague that he had never heard a better talk given in graduate school by students or professors. Our seminars do not often duplicate that quality, but they do average better than our reasonable expectations. ●

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★ ★ ★ ★ ★

COPERNICUS AND GRAVITY

Gravity is nothing else than a natural force implanted by the Creator of the world into its parts, so that, coming together in the shape of a sphere, they might form a unified whole.—*Nicolaus Copernicus.*

The Special Library

(Continued from Page 81)

chemists and chemists to patent agents; to find his way around in languages other than his own; to administer a group combining all these functions; and to cooperate with, discuss with, help, and placate his fellow scientists.

What are the rewards for this? Let us dismiss the salary picture first by stating that the scales are comparable with, and in some cases identical to, the scales of other scientific workers. The information officer is a scientist, and more—but there is this to remember: In counselling students, there is often a tendency to oversell a job, by inflation techniques as to its importance, or by other methods. The rewards of the information officer's work render such actions not only undesirable, but unnecessary. Look at the "Situations Open" pages in *Chemical & Engineering News* or *Special Libraries*—or any other pertinent professional journal. The librarian is in demand; his talents are wanted; and his is the most satisfying of rewards—a high level of professional development in a narrow area, resulting in a high degree of specialization and a sense of essentialness in the job. ●

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Science Tackles the Universe

Although most of the scientific enterprises of today are executed by large groups of scientists, the basic idea behind many of them originated with an individual with enough foresight and knowledge to appraise the chances of success and evaluate the possible benefits. Dr. Lloyd V. Berkner, an American geophysicist and President of the International Council of Scientific Unions, is the spiritual father of the International Geophysical Year.

In 1950, in conversation with some of his colleagues, Dr. Berkner declared that the progress in scientific investigation which had been made during the past twenty-five years warranted an international program of scientific studies. That remark started a series of deliberations and intensive planning sessions which culminated in the opening of the International Geophysical Year on July 1, 1957.

Dr. Berkner hopes that the success of this enterprise might lead to similar projects in other areas of endeavor. Speaking before the Fifth National Conference of the United States National Commission for UNESCO in 1955 he stated, ". . . the International Geophysical Year enables the scientists of every nation to organize their energies towards significant scientific goals. It is a model that might be applied to other important problems."

UNESCO has published a 72 page illistrated booklet entitled, "The International Geophysical Year" which tells the story of the various projects to be conducted as national contributions to IGY*. Director-General Luther H. Evans, in a brief preface to this publication reflects Dr. Berkner's hope that IGY might inspire other cooperative efforts:

"Scientists of more than fifty nations and with widely different training and skills are joining together for a united undertaking. Never before, except for war, have so many of them been mobilized for a common cause.

"The driving force in this case is for a better knowledge of our planet, the earth. Through the International Geophysical Year, there will be exploration of the atmosphere and beyond. Balloons will be topped by rockets and high altitude projectors which, in turn, will be followed by satellites believed by many to be the prelude to space travel.

"In addition to publishing this concise description of the International Geophysical Year*, and its programme and possible benefits, UNESCO also plans to bring the general public a knowledge of this research effort and its methods by means of a travelling exhibition.

"UNESCO can be justly proud of its financial support to the International Council of Scientific Unions in the early stages of the International Geophysical Year and its continuing support of the Special Committee which has been planning the work. Individual national efforts will be responsible for the scientific observations, but the collaboration between nations which makes everything fit into its place is furnished by the Special Committee.

"Through the International Geophysical Year the various cooperating nations will greatly advance our knowledge of the earth on which we live and will give an inspiring example of international understanding and cooperation." ●

—UNESCO NEWSLETTER

* (*The International Geophysical Year* is available from the UNESCO Publications Center, 152 West 42nd Street, New York, N. Y. Columbia University Press also handles UNESCO publications.)

★ ★ ★ ★ ★

Man learns from two books: the universe, for the human study of the things created by God; and the Bible, for the study of God's superior will and truth. One belongs to reason, the other to faith. Between them there is no clash.—*Pope Pius XII.*

★ ★ ★ ★ ★

(Scientists) are ever inquiring "whence" things are, not "why"; referring them to nature, not to mind; and thus they tend to make a system a substitute for a God . . . —*Cardinal Newman.*

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Specific sections outline the opportunities which the firm offers to specialists in mathematics, physics, ceramics, chemistry, and metallurgy and to mechanical, electronic, systems, ceramic, chemical and industrial engineers.

The book is available to college seniors majoring in science, graduate students in science or engineering, science teachers, or anyone with a B.S. degree or higher. It may be obtained by writing Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N.Y. Ask for Booklet L-199.

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The problem for statesmen of this age is how to educate the masses, and literature and science cannot give the solution.—*Cardinal Newman.*

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New Books

Biology

• *By* ELSBETH KROEBER, WALTER H. WOLFF and RICHARD L. WEAVER. D. C. Heath and Company, Boston. 1957. $4.68.

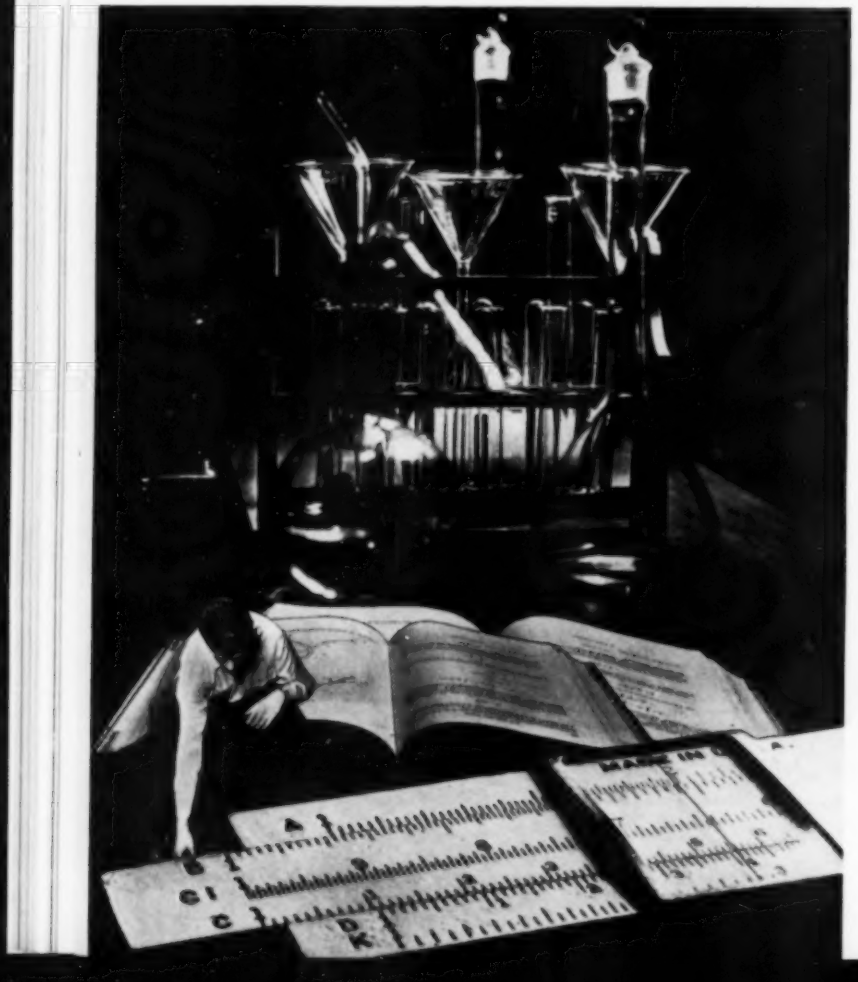
Biology is a new and different text designed for teaching biology at the high school level. Its aims are to encourage the student's interest in his own body and his immediate environment; to stimulate his imagination in respect to the world around him, past and future; and to develop scientific attitudes and habits by incorporating the scientific method into the text and exercises.

The amount of material covered is more than adequate, current and functional. The data has been expressed simply, with special attention to excluding difficult non-science words. The essential technical terms are clearly defined. The style is interesting, informative and stimulating.

The illustrations are an integral part of the text and are numerous and excellent. In addition to many colored plates, almost every page has an illustration that uses color to emphasize the center of interest.

The introduction is well conceived and well executed. It defines biology and science, interprets the role of the biologist, and answers the question, "Why study biology?"

Photo by Vic Kelley



The book is organized into ten comprehensive units, which are divided into chapters. At the end of each chapter are a review; a list of technical terms introduced in the chapter; a testing exercise which necessitates the expression of concepts rather than fostering memorization of terms; "Do It Yourself" experiments which are within the range of the physical facilities of the school; and suggestions for "Adventures in Reading."

A section on field trips and an appendix are also included. The section on field trips emphasizes the importance of outdoor biology. It is divided into nine trips including one to a vacant city lot. Each trip is outlined in detail including materials needed, things to look for and objectives. The appendix contains an anatomy of representative animals of several phyla. It is designed to be of use to students preparing for college entrance examinations.

In addition to the aids already indicated, a glossary with a pronunciation key, a table of contents and a general index facilitate the use of the textbook.

It is my opinion that *Biology:*

(1) Fulfills the aims and objectives as stated by the authors and conforms to the purposes of science instruction in education in terms of subject matter content and in the broader implications of living.

(2) Represents a valuable instructional aid in content, organization, illustrations, and exercises and experiments on the pupil level.

(3) Presents material related to pupil needs in terms of maturity levels and interests.

(4) Assists the pupil to formulate basic scientific and biological concepts and to develop a background and an understanding of scientific data through the practical application of the scientific method of learning and problem solving.

Doris L. Heil
Pittsburgh Public Schools

Experimental Psychology and other Essays

• *By* I. P. PAVLOV. Philosophical Library, New York. 1957. Pp. 653. $7.50

This collection of basic writings of Pavlov covers a span of more than fifty years of the long, productive, and at times stormy career of the famous Russian physiologist. From a presentation of some original data on the accommodating mechanism of the blood vessels, the reader is led through Pavlov's work on digestion, higher nervous activity, brain physiology, detailed treatment of the conditioned reflex, localization, sleep and hypnosis, and finally to excursions into problems of psychiatry and psychology. There is an extensive overview and critique of the significance of Pavlov's work by Koshtoyants to open the book, followed by a brief (4-page) autobiography. The final selection of fragments from the "Wednesday" gatherings offers a special treat and challenge to psychologists.

While much of the material in the first two-thirds of the book is almost pure physiology (with periodic backhand slaps at psychology), those interested in brain physiology and the details of Pavlov's original conditioning experiments will feel at home here. For most psychologists, the final third of the book will be both informative and agitating.

Pavlov's style is quite readable (despite some repetition), but extremely positive and dogmatic in tone. One is astounded at his scope of knowledge, and his

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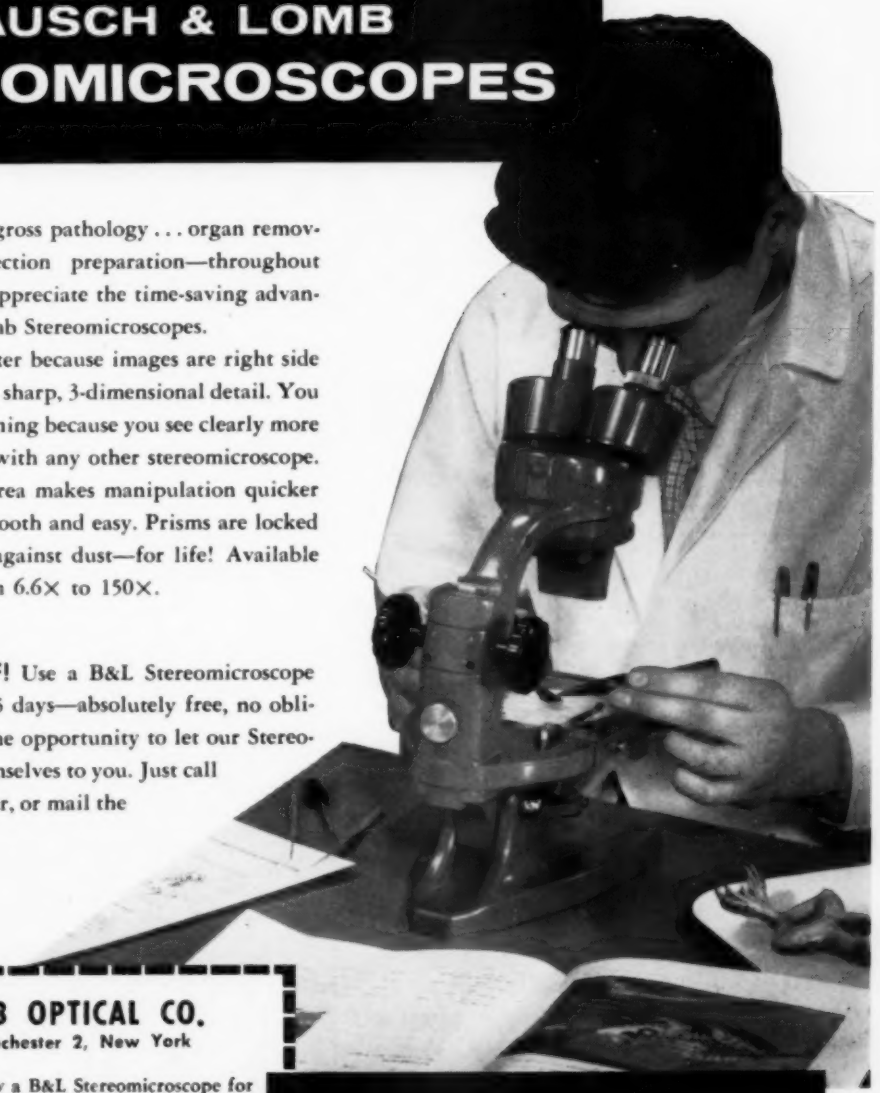

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close acquaintance with the events of his day in both psychology and psychiatry.

There are many provocative academic skirmishes, with Pavlov invariably "proving" his point by falling back on the data of his conditioning experiments. He takes issue with Psychology in general for its subjectivism and failure to justify its existence as a science ("experts at playing with words"), with Lashley for his opposition to the theory of reflexes, and with Kretschmer for his mistaken or inadequate classification of types. Gestalt psychology is assailed for its revolt against the analysis of human behavior and experience; Sherrington, Pierre Janet, Yerkes, and Koffka in turn are dealt with in no uncertain terms. Such notables as Koehler and Kurt Lewin are treated in a particularly rough manner.

The themes of the "omnipotence of CR technique" for the final answers to both physiological and psychological problems, Pavlov's materialistic monism, his insistence on strict experimental method, and his disdain for psychology run throughout the book. But one may weary of having far-reaching human questions so easily solved by recourse to data from the ever-present dogs of Pavlov's laboratories. His physiological explanations of schizophrenia, hysteria, and other mental disorders leave little or no room for a dynamic viewpoint of human problems.

This book belongs in the libraries of physiologists, psychologists, and philosophers as a valuable source of material, historical, critical, and controversial, on some very important problems of human behavior.

William J. Schanberger
Psychology Department
Duquesne University

Teaching Science in the Secondary School

• *By* R. WILL BURNETT. New York. Rinehart and Co., Inc. 1957. Pp. 302. $5.25.

This text designed for methods courses in teacher-education institutions presents the general principles and their classroom applications of high-school science teaching. The author found it convenient to organize his material into five large divisions or sections.

The discussion in section one takes up some contemporary problems of science teaching resulting from social change and various advances in psychology and education. This is followed by a critical review of traditional types of teaching characterized by authoritative and mechanical textbook teaching. We are warned that such teaching takes the subject matter out of its functional setting and that this stifles the desire for learning. Newer programs and methods are advocated which emphasize the development of habits of scientific thinking and scientific attitudes which are developed by students through self-direction and critical thought. These alternatives are a great deal more significant than the subject matter content itself.

Section two deals with the foundations of modern science teaching by reaching back into the history of science teaching in American schools. This is followed by an examination of certain psychological principles applicable to modern science teaching, such as the nature of motivation, transfer of training as it affects scientific knowledge, and learning as experience.

This brings us to the third major division of the book which argues that the science program be properly organized and taught. Not all science teaching brings out the need for scientific thinking and attitudes but there is a type of training that will do it more surely. The technique of various approaches such

as the lecture, demonstration, discussion groups, student reports, research, the use of audio-visual aids, and testing and evaluation are described and compared.

Section four, written by other hands—largely experienced teachers, illustrates how these teachers approach their classroom work and how they apply principles developed earlier in the book to such problems as combating prejudice through science teaching, building an experimental unit in mental hygiene, meeting the needs of gifted students, and an example of the structure and teaching of a core unit on atomic energy. These naratives aid not only in understanding principles but also how to utilize them.

The fifth and last part, a single chapter, covers broadly the professionalization of secondary science teaching by setting forth some research on such topics as the training and status of science teachers, critical shortages, and agencies of in-service training such as professional organizations

One last comment. This is an up-to-date manual on principles, procedures and practices whose author seeks to salvage what still remains effective in the traditional methodology but whose chief concern is the extension of procedures to newer techniques which accent the functional, the operational, and the instrumental.

However, after a textbook completes its report, it still remains for the teacher to conceive of learning as a living creative process, and to use and integrate approaches from the various theoretical orientations that involve discovery, insight, and problem solving through such means as investigation and the search for relationships, significance and solutions. Our author succeeds in guiding this process.

The book is illustrated and the selected references suggest the important writings in the field.

Francis Kleyle, Ph.D.
School of Education
Duquesne University

The Milky Way

• *By* BART J. BOK and PRISCILLA F. BOK. Third Edition. Cambridge, Massachusetts: Harvard University Press. 1957. Pp. 269. $5.50.

The authors of this book are well known for their researches on the Milky Way. While the title page describes the volume as a third edition, except for the title, it is really a new book.

The tone of the book is best described by its opening sentence: "In this book we invite you to join us on a brief tour along the road to the heavens of the Greeks." The reader has, throughout the book, the feeling that the authors are his personal friends. The known facts and the methods used in the study of the Milky Way are thoroughly covered. In addition the motion of the galaxy and its parts, its structure, changes and future are discussed in terms of the most recent theories of astronomy.

The physical appearance of the book is excellent. The typography and illustrations are excellent. The photographs are exceptionally clear and well integrated with the text. *The Milky Way* is not only an interesting book to read, but also pleasant to the eye.

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Teachers Return to School

When the fall school term opens this year, some 800 high school teachers of science and mathematics will themselves be returning to school for a concentrated year of study. Under the sponsorship of the National Science Foundation, 16 universities geographically distributed throughout the country will be offering specially designed courses to bring selected high school teachers up to date in the various fields of science and in mathematics. The program, costing approximately $4¼ million, has been developed by the Foundation in response to the express desire of Congress that the Foundation make a broad frontal attack in meeting the need for improved teaching of science and mathematics at the high school level.

Universities participating in the program are as follows: Chicago, Colorado, Harvard, Illinois, Michigan, North Carolina, Ohio State, Oklahoma State, Oregon State, Pennsylvania State, Stanford, Texas, Utah, Virginia, Washington University at St. Louis, and Wisconsin.

Within a very general framework prescribed by the Foundation, each university has planned and developed the type of institute best suited to its own staff and facilities. In addition to the special year of intensive training, the courses in most instances also carry full academic credit.

High school teachers selected to participate in the institutes will receive stipends of $3,000, plus an allowance of $300 for each dependent, up to a maximum of four. Additional allowances include travel, up to a maximum of $80 for each of two trips from the teacher's home to the institute, and funds for tuition and books. Financial assistance of this type represents the only means by which the majority of high school teachers can take time off for their own improvement.

Most of the participating universities are offering courses for the teachers in biology, chemistry, mathematics, and physics, plus some supplementary work in education. Some of the schools are also including courses in the history of science.

Many teachers will be introduced for the first time to modern, large-scale research facilities including the cyclotron. van de Graaff generator, radiotelescope, mass spectograph, high-speed computer, electron microscope, cryogenic laboratories, and so on.

The growing demands for scientists and engineers have served, in recent years, to focus public attention on the critical need for effective preparatory work in the Nation's secondary schools. Studies of the situation have revealed that many high school teachers are being called upon to teach the sciences and mathematics without having been adequately trained in these fields themselves; in some instances teachers are called upon to teach subjects in which they have had no previous training. Heavy teaching schedules and endless demands upon their time for extracurricular activities have left teachers little time to improve their own knowledge of science.

The academic-year institutes sponsored by the Foundation are in addition to its larger program of summer institutes. During the summer of 1957, some 5,000 high school teachers attended 91 summer institutes at colleges and universities throughout the United States, averaging between six and eight weeks. These institutes, also, were designed to bring to secondary-school teachers some of the recent developments in science and mathematics.

The Foundation is also sponsoring, for the first time this fall, a series of 21 in service institutes, to be conducted by a number of colleges and universities, after hours, for teachers in the vicinity. ●

★ ★ ★ ★ ★

Faculty Research Activities

A survey of faculty engaged in scientific research activities in United States academic institutions, released recently by the National Science Foundation, indicates that in 1953-54, 70,000 scientists and engineers were employed by colleges and universities, about half of whom were performing research on a full- or part-time basis. In a large sense, this group represents a reservoir of the nation's basic science research potential since the survey covered 1,120 institutions capable of performing research in the natural and social sciences. Other academic institutions in the country are primarily teachers' colleges or oriented toward education in the liberal arts.

The estimates derive from the Foundation's survey of scientific manpower at colleges and universities for the academic year 1953-54, and are based on data returned by 987 responding institutions. These institutions reported 62,000 faculty members in the natural and social sciences, and an estimate of 8,000 was made for non-response. Of the respondents, 180 were large institutions, i.e., primarily those having graduate schools in the scientific professions. These accounted for 46,500 of the total scientific faculty, and for 95 percent of the total research time reported.

The reported faculty members included both full- and part-time scientists and engineers engaged in any or all of the normal duties of a faculty member—teaching, research, and community service. Translating part time and full time into full-time equivalents, about 30% of the total time was devoted to research activities.

The Foundation's report presents number of faculty in these institutions and the percent engaged in research in six different types of organizations within the universities: arts and sciences, engineering, health, professional, agriculture, research organizations, and other professional schools. About 75 percent of the total faculty employed were in the arts and sciences, engineering, and medical schools.

The report, "Faculty Scientific Research Activities at Colleges and Universities, 1953-54," is Number 6 in the Foundation's series entitled *Reviews of Data on Research and Development*. Copies may be obtained by writing to the National Science Foundation, Washington 25, D. C. ●

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It is a distinguishing difference of the GENATRON that electrical charges, conveyed by a non-metallic material, are established **directly upon the discharge terminal.** The attainable voltage accordingly depends only upon the geometry of that terminal and the dielectric strength of the medium by which it is surrounded.

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DISCHARGE TERMINAL Charges accumulate on, and discharge takes place from, the outer service of a polished metal "sphere"—or, more accurately, an oblate spheroid.

The upper hemisphere is flattened at the pole to afford a horizontal support for such static accessories as must be insulated from ground. A built-in jack, at the center of that horizontal area, accepts a standard banana plug. Connections may thus be made to accessories located at a distance from the GENATRON.

CHARGE-CARRYING BELT To the terminal, charges are conveyed by an endless band of pure, live latex — a CamboscO development which has none of the shortcomings inherent in a belt with an overlap joint.

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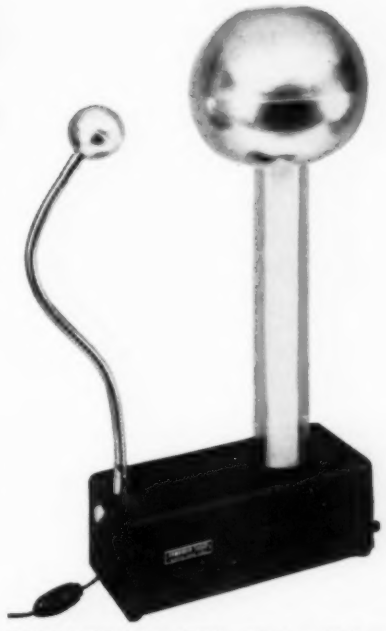
The flat, top surface of the base, (electrically speaking), represents the ground plane. Actual connection to ground is made through a conveniently located Jack-in-Head Binding Post. The base of the Genatron encloses, and electrically shields, the entire driving mechanism.

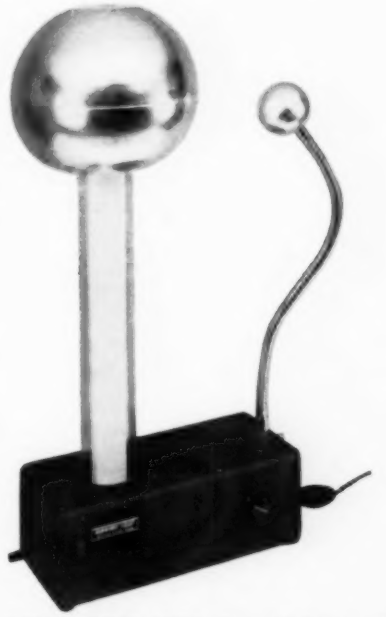
PRINCIPAL DIMENSIONS The overall height of the GENATRON is 31 in. Diameters of Discharge Ball and Terminal are, respectively, 3 in. and 10 in. The base measures 5¼ x 7 x 14 in.



GENATRON, With Motor Drive

Operates on 110-volt A.C. or 110-volt D.C. Includes: Discharge Terminal, Lucite Insulating Cylinder, Latex Charge-Carrying Belt, Discharge Ball with Flexible Shaft, Accessory and Ground Jacks, Cast Metal Base with built-in Motor Drive, Connecting Cord, Plug, Switch, and Operating Instructions.

No. 61-705 - - - - $98.75



GENATRON, With Speed Control

Includes (in addition to equipment itemized above under No. 61-705) a built-in Rheostat, to facilitate demonstrations requiring less than the maximum output.

No. 61-708 - - - - $109.00

No. 61-710 Endless Belt. Of pure latex. For replacement in No. 61-705 or No. 61-708. **$3.00**

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